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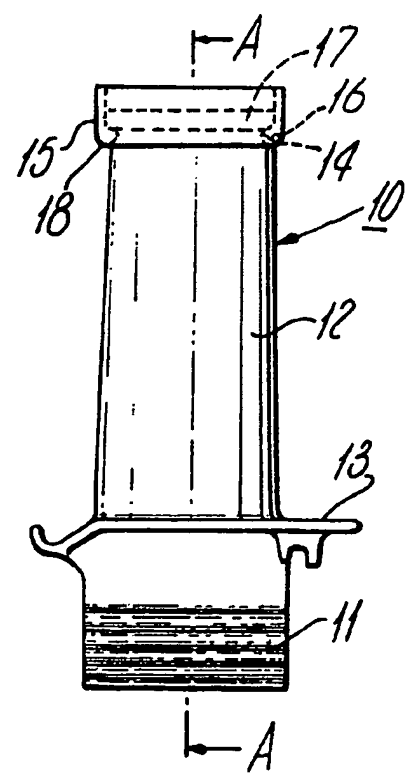
(54) **Vibration damped rotor blade for a turbomachine**

(57) A shroudless rotor blade 10 for a turbomachine is provided at the tip of the aerofoil 12 with a vibration damper 15 in the form of a metal band which is shrunk on to the outside surface of the aerofoil 12. A plug 17 is welded to the blade tip to retain the band in place, and the band has protrusions 16 formed on its inner face which locate in recesses 14 formed in the blade.

Fig.1.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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Fig.1.

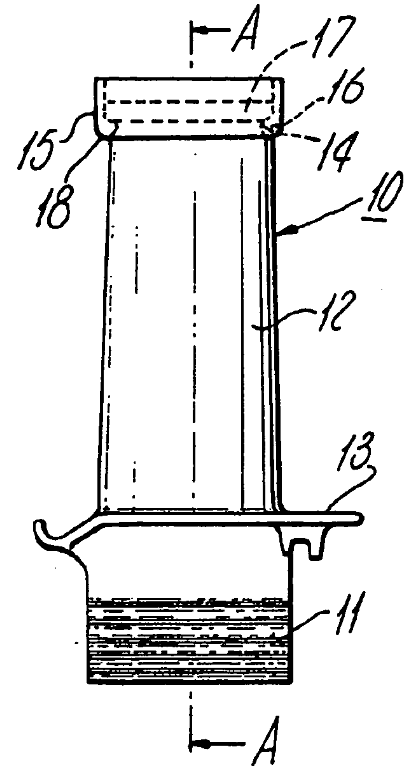
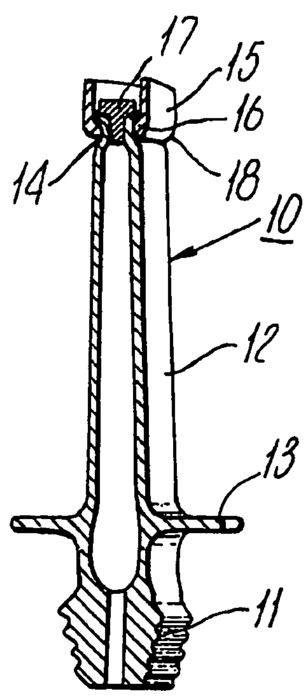


Fig.2.



SPECIFICATION

Vibration damped rotor blade for a turbomachine

This invention relates to blades for use in turbomachines, and is particularly concerned with damping vibrations induced in such blades.

With large compressor blades, for example, fan blades of a by-pass type gas turbine engine, it is known to use platforms, commonly called snubbers, at locations along the aerofoil portion to damp vibrations due to twisting, flutter and flapping of the blade. These snubbers interact with one another to form effectively a continuous platform which damps the vibrations. Such snubbers add undesirable weight therefore the blade roots and the discs or drums on which the blades are mounted, have to be considerably strengthened to withstand the high centrifugal forces on the snubbers. Furthermore, the provision of snubbers complicates the manufacturing and machining processes, compromises the aerodynamic efficiency of the blade, and introduces highly stressed zones at vulnerable regions of the blade. Therefore, there is a strong incentive to eliminate snubbers.

It is also known to provide turbine blades with tip shrouds which serve to minimise gas leakages at the blade tips, and provide damping of vibrations of the blades in much the same way as the snubbers do on compressor blades. Here again turbine rotor assemblies embodying blades with tip shrouds suffer from many of the disadvantages enumerated above, and there is a strong incentive to eliminate the use of tip shrouds and to deal with the problems of vibration damping and controlling tip seal clearances separately.

It is also known to damp shroudless blades by resilient blocks fitted under the root platform but this requires a larger chord blade to obtain sufficient flexure to enable damping to be effective. This in turn results in increased disc rim loads.

The invention as claimed, offers a way of damping vibrations induced in blades which do not have snubbers, tip shrouds, or other known forms of vibration dampers.

The invention as claimed provides a vibration damper at the tip of the blade, and damping is achieved by coulomb friction as the aerofoil tip moves relative to the band due to vibration.

The present invention will now be described, by way of an example, with reference to the accompanying drawings, in which:

Figure 1 illustrates, schematically, one form of turbine blade incorporating the present invention, and

Figure 2 illustrates a cross-sectional view of the blade of Figure 1 taken along line A—A of Figure 1.

Referring to Figure 1 there is shown a blade 10 for a turbine of a gas turbine aero-engine. The blade 10 comprises a convention fir-tree root portion 11, which in use is located in a complementary shaped recess in a rotor hub, disc or drum, and an aerofoil shaped portion 12 upstanding from a blade root platform 13.

The blade 10 is of a thin walled hollow construction and the external profile of the aerofoil 12 adjacent the tip of the aerofoil that is remote from the platform 13 is provided with a recess 14. A vibration damper 15 in the form of a discrete band of metal is provided at the tip of the aerofoil. The band 15 is an interference fit, or a shrink fit, on the external surface of the aerofoil. The band 15 has a protrusion 16 on its inner surface that locates in the recess 14.

The hollow cavity of the blade is blanked off by a plug 17 which is welded to the aerofoil portion 12. The plug 17 also serves as a retaining member to retain the band on the aerofoil against the centrifugal loads on the band 15.

The band 15 extends along the length of the blade a short distance and extends beyond the tip of the aerofoil and encompasses the plug 17. The band 16 also assists in forming an aerodynamic seal by deflecting radially moving air where it strikes the outer corner 18 of the band 15.

The band 15 may be made of metal or ceramic, and may be cast, or a rolled and welded strip.

In use movement of the aerofoil 12 relative to the band 15 due to vibration is damped by coulomb friction between the aerofoil 12 and the band 15.

The resonant frequency of the oscillation of the band due to its momentum is turned to provide optimum damping of the predicted vibration of the aerofoil.

CLAIMS

1. A blade for a turbomachine comprising a root portion and an aerofoil shaped portion, wherein a vibration damper in the form of a discrete band is provided around the external profile of the aerofoil at the tip of the remote aerofoil remote from the root portion.

2. A blade according to Claim 1 wherein the aerofoil has a recess extending around its external profile adjacent the tip of the aerofoil and the band has a protrusion that locates in the recess.

3. A blade according to Claim 1 or Claim 2 wherein the aerofoil shaped portion is provided with a retaining member secured to the aerofoil shaped portion and the retaining member co-operates with the band to retain the band on the aerofoil against the action of centrifugal loads on the band.

4. A blade according to any one of Claims 1 to 3 wherein the band is an interference fit on the aerofoil.

5. A blade according to any one of the preceding claims wherein the band extends in a direction along the length of the blade beyond the tip of the aerofoil portion.

6. A blade substantially as hereindescribed with reference to the accompanying drawings.

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